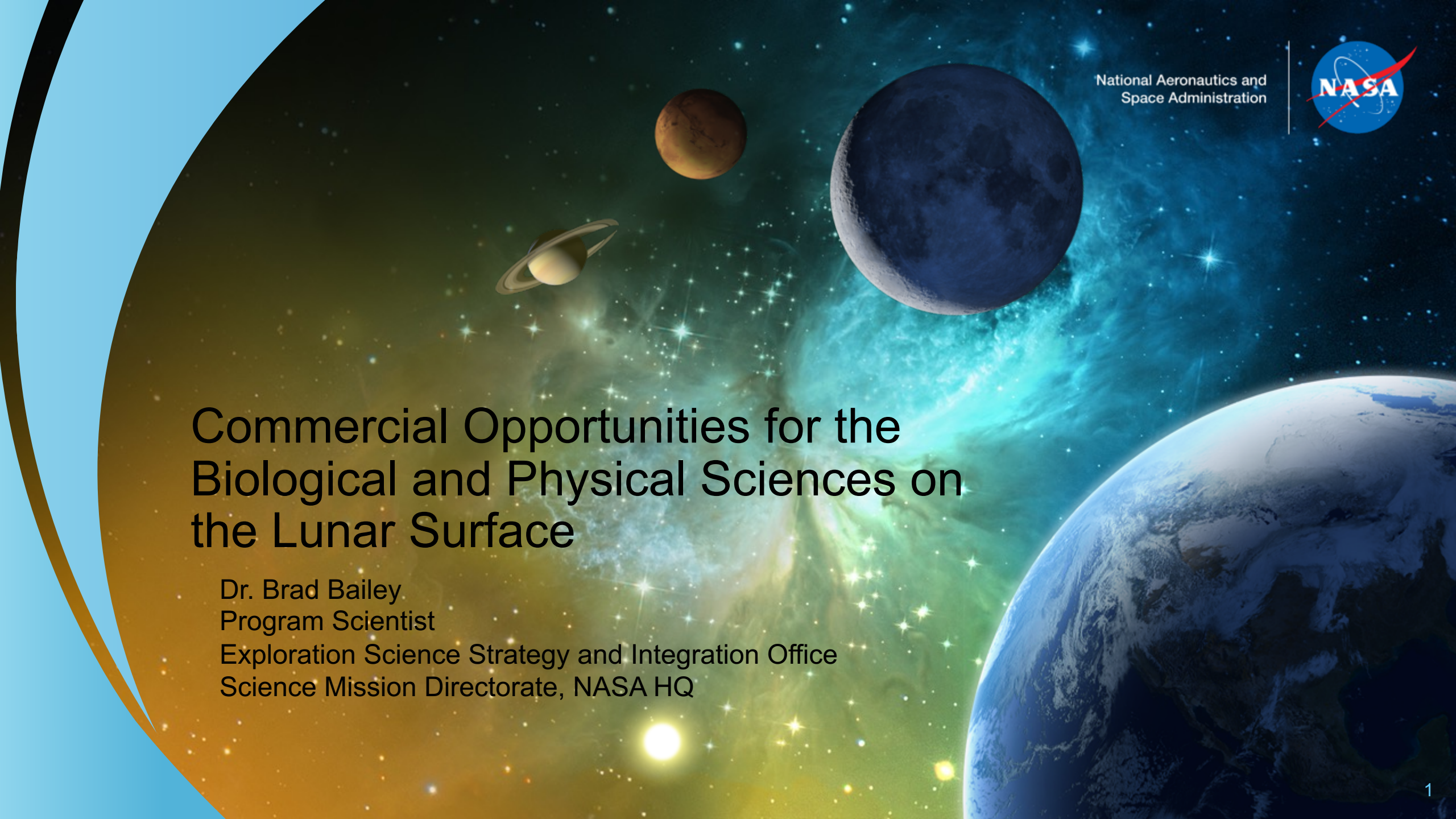


Commercial Opportunities for the Biological and Physical Sciences on the Lunar Surface

Dr. Brad Bailey
Program Scientist
Exploration Science Strategy and Integration Office
Science Mission Directorate, NASA HQ

Delivery Site:
Oceanus Procellarum
Provider:
Intuitive Machines
Task Order (TO) 2 | 2021

Delivery Site:
Lacus Mortis
Provider:
Astrobotic
TO2 | 2021

Delivery Site:
Lunar Pole
Provider:
Astrobotic
VIPER | 2023

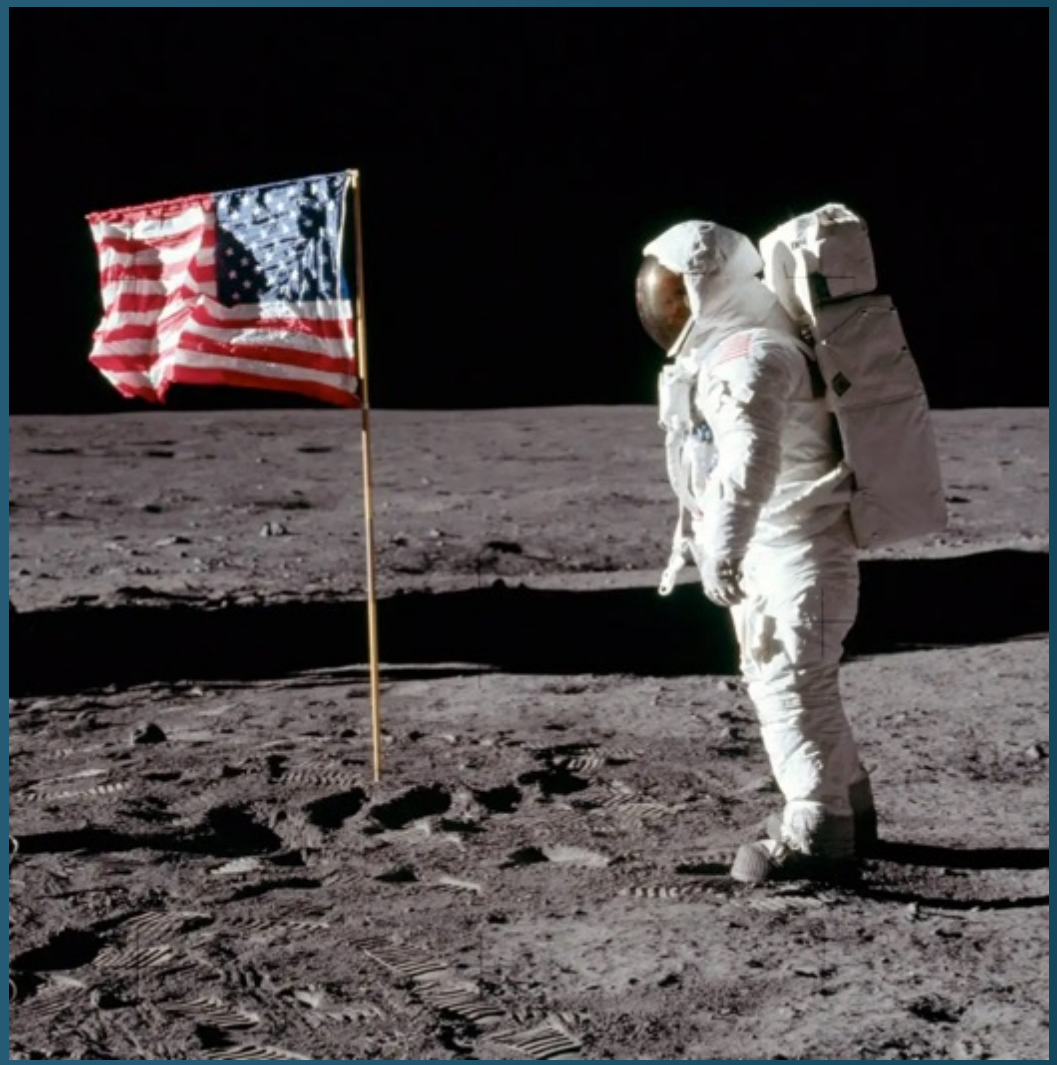
Delivery Site:
Reiner Gamma
Provider: TBD
PRISM-1a | 2023

Delivery Site:
Mare Crisium
Provider: TBD
TO19D | 2023

Delivery Site:
Schrödinger Basin
Provider: TBD
PRISM-1b | 2024

Delivery Site:
South Pole
Provider:
Intuitive Machines
PRIME-1 | 2022

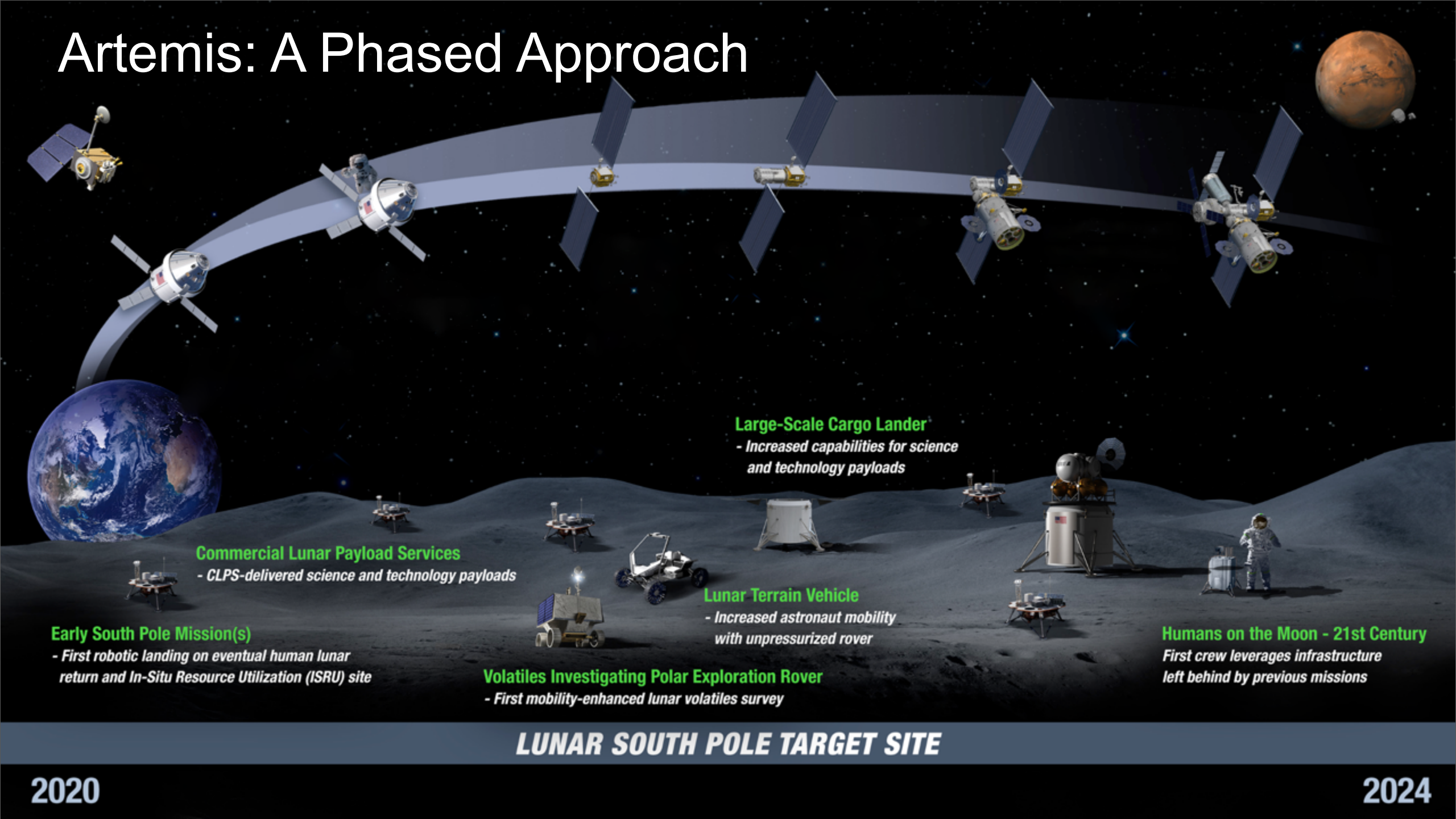
Delivery Site:
South Pole
Provider:
Masten
TO19C | 2022



Agency Priorities

- Using innovative public-private partnerships with US commercial companies and international partners to achieve a sustainable presence on the moon
- Using Gateway to Lunar Surface to facilitate:
  - Human lunar landing by 2024
  - Sustainable missions by 2028
- Enabling new Lunar Science and Technology through:
  - Small commercial lunar landers by 2021
  - Medium-size landers and rovers by 2023

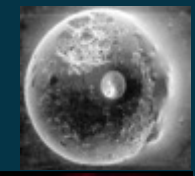
Artemis: A Phased Approach

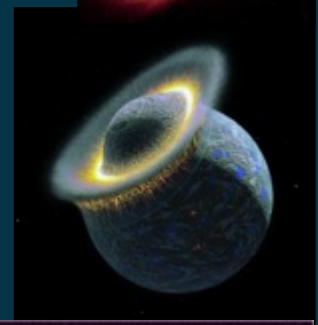


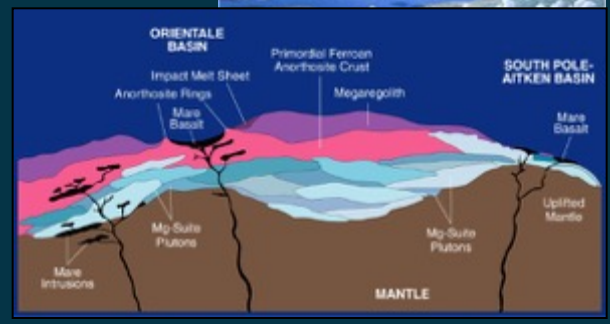
Why the Moon?

- The high scientific value of the Moon has been captured in a plethora of community driven documents. The common scientific themes are:
  - Study of Planetary Processes
  - Understanding Volatile Cycles
  - Impact History of the Earth-Moon System
  - Record of the Ancient Sun
  - A Platform to Study the Universe
  - A Place for Fundamental Science in the Lunar Environment
  - Investigating and Mitigating Exploration Risks to Humans

- These themes drive the lunar surface science objectives
  - Field geology with significant mobility
  - Collection and return of new samples are critical
  - Installation of surface instrumentation
  - Ability to access to regions with cold temperatures







FUNDAMENTAL LUNAR SCIENCE

LIFE SCIENCES
Combined effects of fractional gravity & deep space radiation

FUNDAMENTAL PHYSICS
General relativity, gravitational physics, quantum information science

EXPLORATION PHYSICS
Combustion, fluid dynamics, dust, material sciences

FOOD/DRUG DEGRADATION

Commercial Lunar Payload Services

- Master contracts awarded to vendors to safely integrate, accommodate, transport, and deliver NASA and commercial payloads
  - Using contractor-provided assets, including launch vehicles, lunar lander spacecraft, lunar surface systems, Earth re-entry vehicles, and associated resources
- Tapping into the resources and capabilities of the commercial sector to advance and strengthen America's return to the moon
- NASA wants to be a marginal customer, one of many payload providers
  - NASA does not intend to manage or direct these commercial missions
- Sponsored (programmatic and funding) by SMD in support of NASA's science, human exploration and technology goals

CLPS Vendor Pool

Delivery Site:
Mare Serenitatis
Provider:
Intuitive Machines
Task Order (TO) 2 | 2021

Delivery Site:
Lacus Mortis
Provider:
Astrobotic
TO2 | 2021

Delivery Site:
Lunar Pole
Provider:
Astrobotic
VIPER | 2023

Delivery Site:
Reiner Gamma
Provider: TBD
PRISM-1a | 2023

Delivery Site:
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Provider: TBD
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South Pole
Provider:
Intuitive Machines
PRIME-1 | 2022

Delivery Site:
South Pole
Provider:
Masten
TO19C | 2022

CLPS Payload Ingest Process

Step 1

MD, other Agency, or Int'l Partner Identifies Need for CLPS Delivery

- Representative approaches ESSIO about potential delivery*
- Payload gets added to candidate payload list from which future CLPS delivery manifests will be generated
- Email to:

DAAX David Burns (david.m.burns@nasa.gov),

ESSIO PS Brad Bailey (brad.bailey@nasa.gov), and

ESSIO PE Angela Melito (angela.melito@nasa.gov)

Step 2

Pre-manifesting by CMSB

- CMSB meets to review candidates and allocate payloads across next several CLPS deliveries
- CMSB identifies capacity limits that support competition and non-NASA customer encouragement
- Foundational payloads are identified that could drive delivery parameters.
- CMSB identifies preliminary manifest including set payloads and constrained allocations
- Draft MOAs between ESSIO and Payload MD's/external entities covering cost and data sharing

Step 3

Solicitations & Payload Refinement

- Selection processes employed to fill Step 2 allocations within defined constraints.
- PRISM is the SMD-preferred competitive process to select payloads, and may be used by other MDs
- PRISM solicitation mentions predefined delivery characteristics and other pre-manifested payloads from other MDs, agencies, or international contributions from Step-2 to minimize redundancies
- All payloads mature requirements and interface definitions

Step 4

Manifest Finalization by CMSB

- The CMSB builds final manifests for upcoming CLPS deliveries
- CMSB ensures compatibility with Agency priorities, objectives, and commitments; and compliance to all requirements/limits.
- CMSB ensures payload interfaces/requirements are mature enough to write RFTOP.
- If the Step 2 allocations have not been filled, the CMSB *may* elect to add new payloads to the final manifest if Step 5 schedule can accommodate
- Confirm or update MOAs

Step 5

CLPS RFTOP & Award

- ESSIO works with the CLPS Project office to develop the request for task order proposal (RFTOP)
- Release draft RFTOP to CLPS vendors
- Host workshop with vendors and manifest PIs
- Release final RFTOP
- Review proposals with input from MD stakeholders
- Award task order
- Finalize MOAs

Step 6

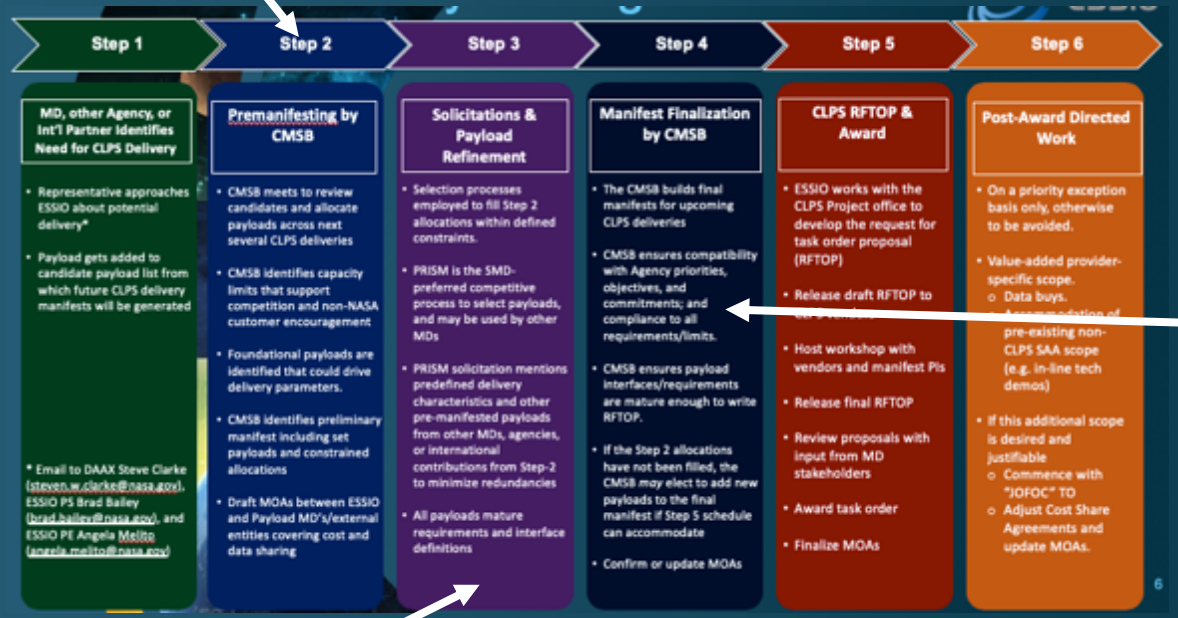
Post-Award Directed Work

- On a priority exception basis only, otherwise to be avoided.
- Value-added provider-specific scope.
  - Data buys.
  - Accommodation of pre-existing non-CLPS SAA scope (e.g. in-line tech demos)
- If this additional scope is desired and justifiable
  - Commence with "JOFOC" TO
  - Adjust Cost Share Agreements and update MOAs.

International Contributions Ingest

Three methods for ingesting international contributions into a CLPS delivery manifest

#1: Co-manifested with other complementary MD payloads (Step 2)



#3: Remaining lander space may be allocated to int'l contributed payload (Step 4)

#2: PRISM payloads may have int'l contributions (<30%) (Step 3)

PRISM Overview

Payloads and Research Investigations for the Surface of the Moon (PRISM)

- PRISM RFI: 238 Responses from the community received
- Catalog of potential instruments

PRISM Solicitations

- PRISM awards will feed the manifests for Task Orders for deliveries from late 2023 onwards
- PRISM solicitations will state location/plan for each delivery, allowing PIs to propose science optimized for those locations
- International contributions to PRISM investigations may be included at up to 30% the total cost of the investigation
- Payloads from other NASA mission directorates, directed payloads, and/or international payloads may also be incorporated into Task Orders.
- Standalone instruments, campaign science, and destination agnostic investigations are intended to be solicited in a future PRISM call

Evolving Capabilities for Decadal-Caliber Science

- New capabilities that would enhance science return, ops, and open new avenues for scientific investigations
  - Mobility
  - Orbital Drop-off
  - Comm Relay
  - Sample Return
  - Surviving the lunar night
  - Articulation
  - PSR Operations

- Parallel Development Paths
  - Study task order to existing CLPS providers
  - NASA in-house development (e.g. VIPER, LEMS)
  - Investigate international contribution (e.g., ESA, CSA)
  - RFI to industry to determine potential commercial sources and availability